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"SOME EFFECTS OF CAPILLARITY ON OIL ACCUMULATION" BY A. W. MCCOY¹

DISCUSSION BY

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Students of petroleum are indebted to Mr. McCoy for the three useful experiments in this paper. His first conclusion is that oil may accumulate in the larger pores and other spaces of rock, regardless of structure. This fact had been recorded previously in the occurrence of oil in lenticular sands, and I had shown its theoretical necessity.² The additional experimental evidence is most welcome. The main argument of the paper is an attempt to show that capillary action possibly may lift the strata into anticlines. This idea appears impossible for four reasons.

First, the pressures created by capillarity are exerted by fluids in open spaces which communicate, more or less deviously, with the ground surface. The perfection of this communication through shale is of the same order as the perfection of transmission of the capillary pressures (assuming that these exist) that are transmitted through shale into sandstone. Moreover, any pressures in the fluids in sandstones are exerted through all spaces, laterally as well as vertically, and would be so equalized through the entire bed of sand that only a local hydraulic gradient would be left to deform the sand. That such slight difference of pressure is unable to tilt a sand need not be argued. Even if the capillary pressures could deform a sand, they would not disturb lower sands along the same axis or lift any of the underlying strata.

Secondly, the amount of pressure available under Mr. McCoy's assumed conditions (p. 802) would not be "the difference in the

¹ *Jour. Geol.*, XXIV (1916), 798-805.

² C. W. Washburne, *Transactions A.I.M.E.*, L, 831.

capillary pressures of oil and water for that size of opening." It would be only (a) the pressure exerted by the water-oil surfaces beneath the oil, less (b) the pressure of the oil-gas surfaces on the hemiglobules of oil that are being forced out of the small capillaries into larger spaces. Since (a) and (b) are of similar magnitude, their difference, amounting only to a fraction of an atmosphere, cannot be considered a cause of rock deformation.

In other words, Mr. McCoy takes a wrong basis for his calculation of capillary deforming force, and this nullifies the calculation at the end of his paper.

Thirdly, the amount of capillary pressure exerted in a group of tubes of variable size and having many lateral connections, as in rock, cannot exceed the pressure in the largest of these tubes plus the head required for an adjusting flow of gas or liquid through the lateral connections from the finer to the larger pores. If shale is cut by minute open joints or fissures, the low capillary pressures in the latter must limit the effective capillary pressure per square inch in all connecting pores.

Pores that are completely closed above the point of the highest liquid-gas surface within them would feel the complete pressure produced by that surface. Capillary action in completely inclosed pores would not contribute to the general pressure or affect the problem under discussion. In all connected pores, the general capillary pressure could not rise appreciably above the minimum capillary pressure, determined in the largest pores or joints.

I believe that the second and third arguments reduce the probable effective capillary pressure, under the conditions of Mr. McCoy's problem, to a maximum of one or two atmospheres, if the rock is cut by any minute open joints or large pores. Certainly the pressure of 200 atmospheres, which he deduces, is out of the question as a general capillary pressure in rock.

Fourthly, there is no definite orientation to capillary pressures in rock-pores. They push and pull every way and tend to balance each other. The ideal distribution of water, gas, and oil assumed by Mr. McCoy would cause a small capillary pressure of definite

orientation, but the assumed distribution is improbable. The probable original distribution is a sand filled mostly with water and imbedded in shale the pores of which are filled with water, oil, and gas, without any regularity or order.

The three useful experiments so carefully described by Mr. McCoy are worthy of careful study by students of oil, and I trust that we may have more experiments from the same author.